

An Analysis of a Tall Structure with Shear Panel and floating Columns in Seismic Zone IV by STAAD Pro Software

Munish Kumar Singh, Prof. Afzal Khan

Department of Civil Engineering, Millennium Institute of Technology & Science, Bhopal, Madhya Pradesh, India

ABSTRACT

For effective design and good construction practises of multistory buildings, numerous prior studies have been conducted. When an earthquake strikes a palace, seismic stresses are produced at the building's floor level. A variety of structure damage was seen after the earthquake. This study was conducted in seismic zone IV. In this work, we examine how tall structures with and without floating columns behave seismically. There are various situations in multistory buildings when it may be difficult to place a column in a certain spot.

This study compares two multistory buildings, one of which supports its columns directly from the ground, and the other of which has floating columns in various locations. We prepared the model for the same height, the same plan, and the same loading condition for this analysis using the Staad Pro software. We are using an 11-story building with a 33.8-meter overall height and a layout that measures 18.92 by 19.78 metres for our analysis. There are 50 columns in the building, and 12 of them are supported by ground floor beams rather than the ground.

These columns are termed as floating columns. We are providing a shear panels in those locations where the columns are supported. This shear wall transfers the load (coming from the floating columns) to the wall supporting columns. By considering these conditions we analysis both structures and find out the results of using floating columns in the same building. In this analysis to comparison of behavior of tall buildings using with and without floating column is concluded on parameters maximum beam moment, maximum beam shear and maximum nodal deflection and volume of concrete and volume of steel .. By considering these conditions we analysis both structures and find out the results of using floating columns in the same building. There is small difference in quantity of concrete in building having floating columns and building without floating columns. The Quantity of concrete for building having floating columns is 654.6 CUM and for Building without floating columns is 666.4 CUM. In this study we concluded that with increase in ground floor column the maximum displacement; inter storey drift values are reducing.

INTRODUCTION

➤ Many urban multistory buildings in India today have open first storey as an unavoidable feature. This is primarily being adopted to accommodate parking or reception lobbies in the first storey. In present scenario buildings with floating columnis a typical feature in the modern multistory construction in urban India. Such features are

highly undesirable in building built in seismically active areas. This studyhighlights the importance of explicitly recognizing the presence of the floating column in the analysis of building. Alternate measures, involving stiffness balance of the firststorey and the storey above, are proposed

How to cite this paper: Munish Kumar Singh | Prof. Afzal Khan "An Analysis of a Tall Structure with Shear Panel and floating Columns in Seismic Zone IV by STAAD Pro Software" Published in International Journal of Trend in Scientific Research and Development (ijtsrd), ISSN: 2456-6470, Volume-7 | Issue-3, June 2023, pp.578-599, URL: www.ijtsrd.com/papers/ijtsrd57441.pdf



IJTSRD57441

Copyright © 2023 by author (s) and International Journal of Trend in Scientific Research and Development Journal. This is an Open Access article distributed under the terms of the Creative Commons



Attribution License (CC BY 4.0) (<http://creativecommons.org/licenses/by/4.0/>)

KEYWORDS: Floating Column, Shear Pannels, STAAD.PRO, Bending Moment, Shear Force, Seismic Zone-IV

to reduce the irregularity introduced by the floating columns.

- Floating column rest on the beam means the beam which support the column is act as a foundation. That beam is called as transfer beam. This is widely used in high storied buildings which are used for both commercial and residential purpose. This helps to alter the plan of the top floors to our convenience. The transfer beam that support floating column will be designed with more reinforcement.
- The total seismic base shear as experienced by a building during an earthquake is dependent on its natural period; the seismic force distribution is dependent on the distribution of stiffness and mass along the height. The behavior of a building during earthquakes depends critically on its overall shape, size and geometry, in addition to how the earthquake forces are carried to the ground.
- Buildings with columns that hang or float on beams at an intermediate storey and do not go all the way to the foundation, have discontinuities in the load transfer path.
- In structural engineering, a shear wall is a structural system composed of braced panels(also known as shear panels) to counter the effects of lateral load acting on a structure FEM codes are developed for 2D multi storey frames with and without floating column to study the responses of the structure under different earthquake excitation having different frequency content keeping the PGA and time duration factor constant. The time history of floor displacement, inter storey drift, base shear, overturning moment are computed for both the frames with and without floating column.
- The behavior of a building during earthquakes depends critically on its overall shape, size and geometry, in addition to how the earthquake forces are carried to the ground. The earthquake forces developed at different floor levels in a building need to be brought down along the height to the ground by the shortest path; any deviation or discontinuity in this load transfer path results in poor performance of the building. Buildings with vertical setbacks (like the hotel buildings with a few storey wider than the rest) cause a sudden jump in earthquake forces at the level of discontinuity. Buildings that have fewer columns or walls in a particular storey or with unusually tall storey tend to damage or collapse which is initiated in that storey. Many buildings with open ground storey intended for parking collapsed or were

severely damaged in Gujarat during the 2001 Bhuj earthquake. Buildings with columns that hang or float on beams at an intermediate storey and do not go all the way to the foundation, have discontinuities in the load transfer path.

Tall Structure

- Tall buildings throughout the world are becoming popular day by day. With the advent of modern day construction technology and computers, the basic aim has been to construct safer buildings keeping in view the overall economics of the project. A high-rise building, apartment tower, office tower, apartment block, or block of flats, is a tall building or structure used as a residential and or office use. In some areas they may be referred to as "Multi Dwelling Unit" or "Vertical cities". They have the potential to decongest the urban sprawl on the ground level, and increase the urban density, housing higher number of families in lesser space
- Massachusetts, United States General Laws define a high-rise as being higher than 70 feet (21 m).
- Most building engineers, inspectors, architects and similar professions define a high-rise as a building that is at least 75 feet (23 m) tall.

METHODOLOGY

GENERAL

In this study the behavior of building frame with and without floating column is studied under static load, Dynamic load and seismic loading condition. The Response Spectrum method is adopted for dynamic analysis in the STAAD. Pro.

Two 9 story two bay 3D building frame with and without floating columns are analyzed for static loading using the present FEM code and for dynamic loading using Response Spectrum method. For analysis of the commercial software STAAD Pro. For this study we design a 9- story building tower with all columns supporting to the ground and another same building is design with floating columns. These columns are supported by a shear wall provided in place of brick masonry wall.

Floating column: The columns supported by beams or walls directly not to the ground, are termed as floating columns. These columns transfer the load to the beams and then through beams it is transferred to another column and then to the foundations.

Shear Wall: The wall constructed by reinforcement concrete to resist shear force occurs in the building is termed as shear wall.

We provide shear wall instead of brick masonry wall. By using shear wall there are two measure benefits. one it resists and transmit vertical load and moment easilyto the supporting columns and there is no need to provide extra support. Second it works as wall and hence there is no need to provide masonry wall hence there are miner difference in cost.

Modelling In STAAD. Pro V8i

STAAD.pro offers a state-of-the-art user interface, visualization tools, modeling tools, property assign, powerful analysis and design engines with advanced finite element and dynamic analysis method. STAAD.ProV8i is a computer program developed by Research Engineers International at Yorba Linda, CA in 1997.

STAAD.pro consists of the following:

- The STAAD.pro Graphical User Interface generate the model, assigned property and apply loads. Then analysis can perform using the STAAD engine. After analysis and design is completed, the results show graphically in anal files.
- The STAAD analysis and design engine: It is a general-purpose calculation engine forstructural analysis and integrated Steel, Concrete design.

Before start modeling in STAAD.pro V8i I have solved sample, problems using STAAD.pro and then checked the results obtained from STAAD pro V8i with manual design. The results obtained from STAAD pro V8i were to satisfaction and were accurate as manual design. In the initial phase of project I have done calculations considered dead load, live load, seismic load and wind load.

Problem Statement

This study is based on the comparison of two multistory buildings one having column support directly to the ground and other having floating column in various locations. For this analysis we used STAAD. Pro software and prepare model for same height, same plan and same loading condition. We are taking a 9-story building for analysis having 33.8 m height from ground level and 18.92 x 19.78 m is plan. There 50 columns in building and 12 columns in various different locations are supported in second floor beams not to ground. These columns are termed as floating columns. We are providing a shear wall in those locations to support the columns. This shear wall transfers the load (coming from the floating columns) to the wall supporting columns. By considering these conditions we analysis both structures and find out the results of using floating columns in the same building. These models are analyzed for dead load, wind load and seismic load.

Dead load was designed according to IS: 875-1987(Part 1) and Seismic load was designed using response spectrum method for earthquake zone IV of India using IS: 1903-2002. The details of the modeled tanks are listed below. Modal damping of 5% is considered with SMRF and Importance Factor (I) =1.2

For wall design the four nodes plates are used in the both models. In the output of slab design the longitudinal reinforcements, which coincides with the local x direction of the element, and, transverse reinforcement, which coincides with the local y direction of the element, is provided.

To create a design member, use the Normal Cursor (also known as Elements Cursor) to select one or more analytical beams, then click on the menu item Member>Form Member. Information on Design Members can be selected using the Members Cursor. Details of design members can be seen in the Members Table.

To delete a design member, use the Members to select it and press 'Delete' on the keyboard or from the Edit menu.

Note that an analytical beam segment can only be part of one design member definition.

Design members can be designed with either Beam or Column Design Briefs.

To create a design slab, use the Plates Cursor to select one or more finite elements, then click on the menu item Slabs>Form Slab. Information on design slabs that have been created is listed in the Slabs Table.

Assumptions

The following various assumptions were made before the start of the modellingprocedure so as to maintain similar conditions for all the two models:

- Only the main building frame made by column and beam is considered for analysis. The load of slab and staircases are assigned directly to the beams in both models.
- 230 mm thick shear wall with 15 mm plaster on each side will be considered forsupporting the floating columns.
- Floating columns are supported directly to the shear wall provided. These shear walls are supported by ground floor columns.
- Columns are terminated in the second floor. The sizes of floating columns are asusual as other building.
- The beam sizes are 300 X450mm for the plinth beams and 230X450mm are for allother beams in both models.

- There are different columns sizes according to load and moment occurs. Detail of columns are given in table.
- The slab thickness is considered 150 mm and finishing is consider 75mm.
- The beams are resting centrally on the columns so as to avoid the conditions of eccentricity.
- For all structural elements, grade of concrete is taken M-30& and grade of steel istaken Fe-500.
- Cover for the Beams is provided 25mm and 40mm for the columns and 35mm for the shear walls.
- The footings are not designed. And supports are assigned in the form of fixedsupports.
- Seismic loads are considered in the horizontal direction only and the vertical direction are assumed to be insignificant.
- Seismic Zone-IV is considered for the calculation of seismic load.
- Sizes of members and model details are as follows: (All dimensions are in mm)

Table 4.1 Building Description

S. No	Description	Building without floating columns(mm)	Building having floating columns(mm)
1	Plan dimensions	18.92 m × 19.78 m (X×Z)	18.92 m × 19.78 m (X×Z)
2	Floor height	3.2 m	3.2 m
3	Dimension of columns	0.35X0.60m, 0.40X0.95m, 0.32X1.275m 0.32X1.90m	0.35X0.60m, 0.40X0.95m, 0.32X1.275m 0.32X1.90m
4	No. of columns	50	38
5	Shear wall Thickness	0	0.23 m
6	Beam size	0.23 X 0.45m, 0.3 X 0.45m	0.23 X 0.45m, 0.3 X 0.45m
7	Total building height	33.8 m	33.8 m
8	Floor Sab Thickness	0.15m	0.15m
9	Grade of concrete	M 30	M 30
10	Grade of Steel	Fe 500	Fe 500
11	Location	Seismic Zone IV	Seismic Zone IV
12	Live Load on floor	2 kN/m ²	2kN/m ²
13	Live Load on landingand corridor area	3 kN/m ²	3 kN/m ²

FREE VIBRATION ANALYSIS

In this analysis 9-storey one bay 2D frame is taken. Fig.4.1 shows the sketchmatic view of the 2D frame. The results obtained are compared with Maurice Petyt[21]. The input data are as follows:

Span of bay = 3.6 m

Storey height = 3.2 m

Size of beam = (0.23 x 0.45) m Size of column = (0.35 x 0.60) m

Modulus of elasticity, E = 21.7 x10⁶kN/m²Density, ρ = 7.83 x 10³ Kg/m³

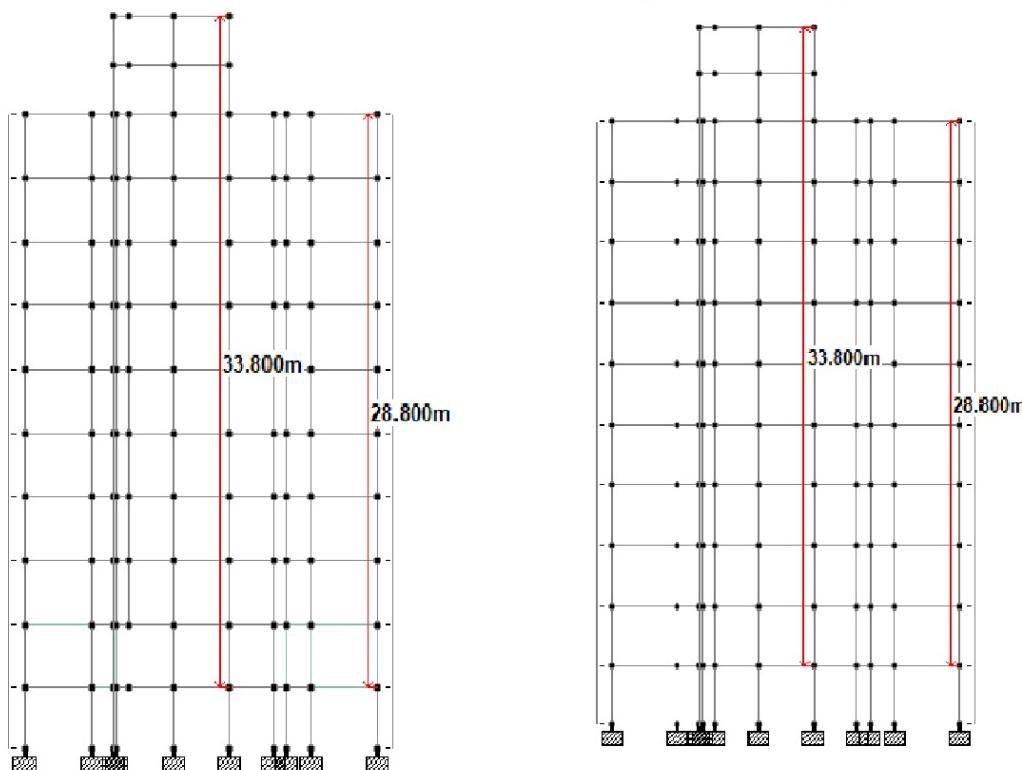


Fig. 4.1 Geometry of the 2-dimensional framework Dimensions are in meter

GENERATION OF STRUCTURE

In this study two concrete frames with and without floating column having same material property and dimension are analyzed under same loading condition.

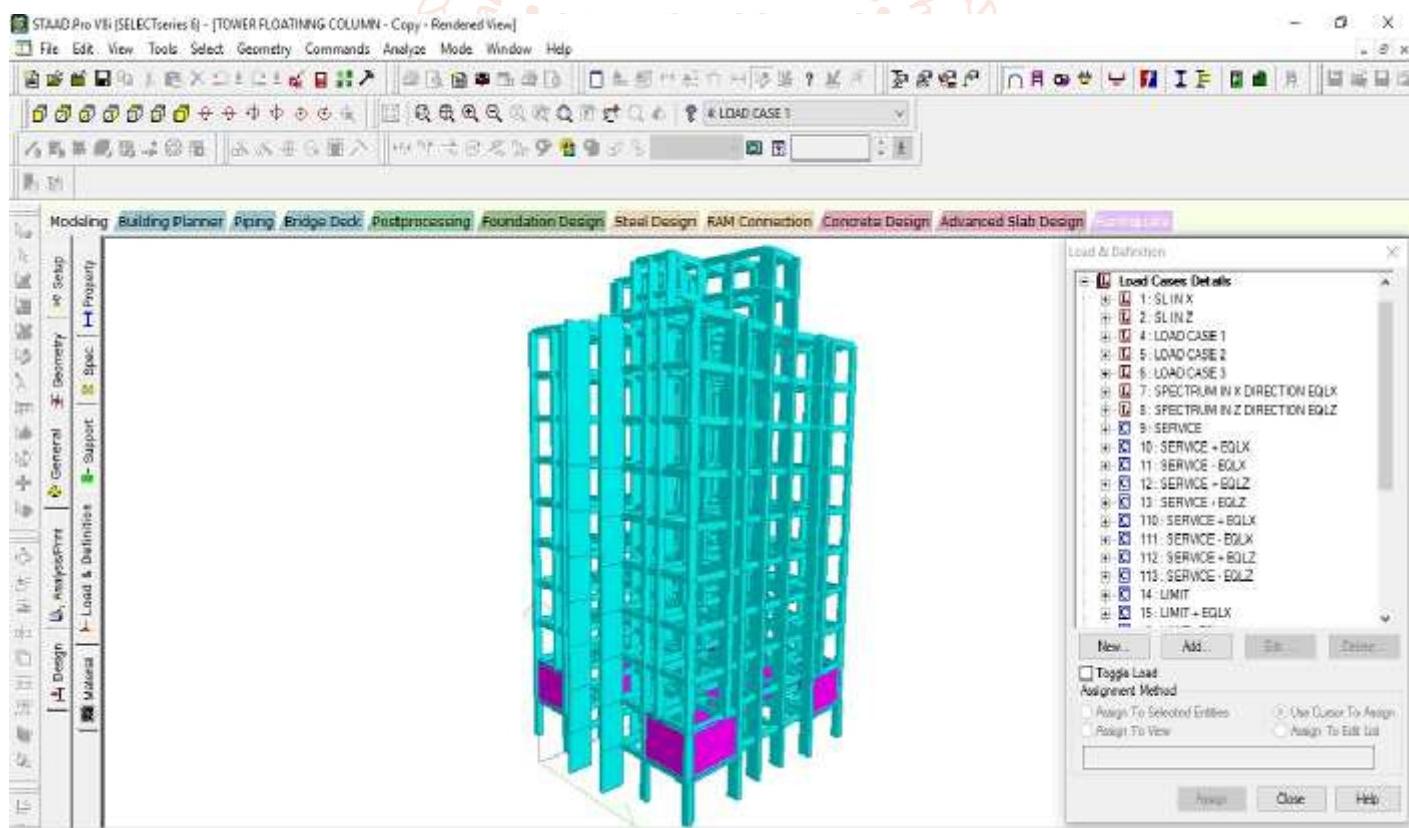


Fig. 4.2 STAAD Generated 3D Rendered model of building having shear wall and floating columns.

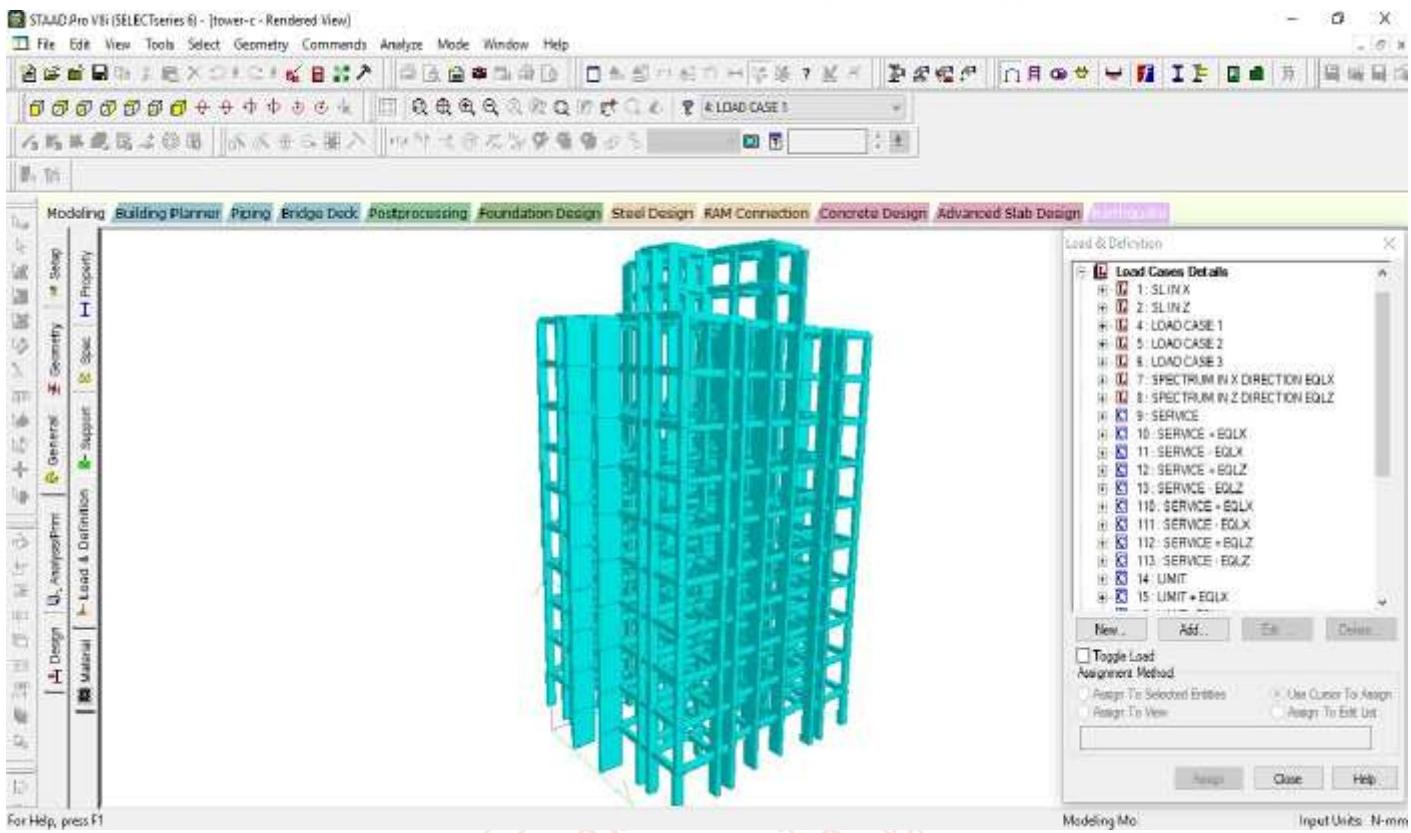
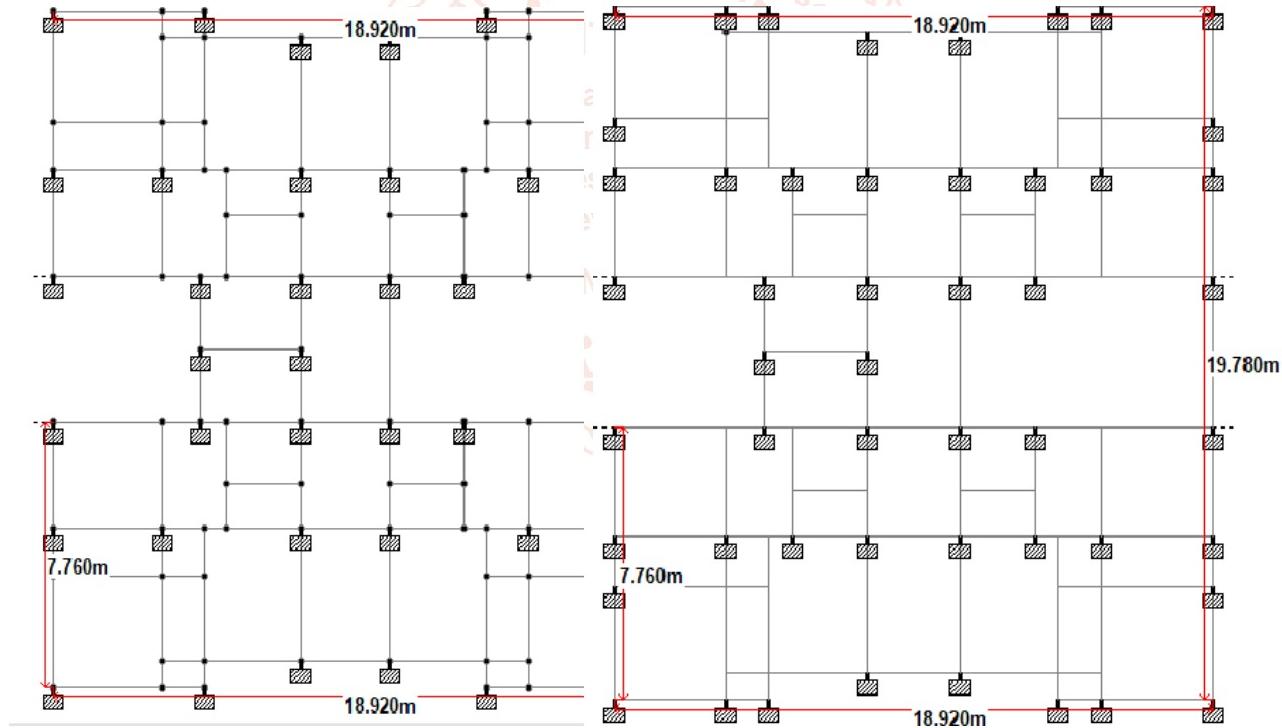


Fig. 4.3 STAAD Generated 3D Rendered model of building without shear wall and floating columns.



a. With floating column and shear wall

b. without floating column and shear wall

Fig. 4.4 Basic Plan of the building with and without floating column and shear wall

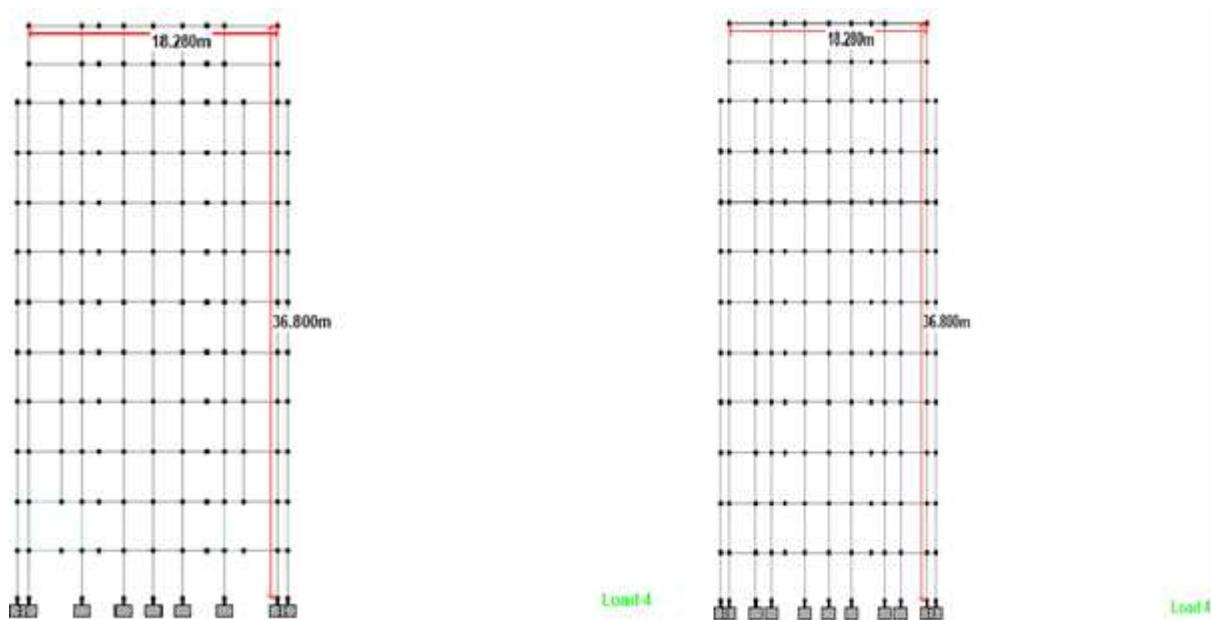


Fig. 4.5 Basic Elevation of the building with and without floating column and shear wall

LOAD CALCULATION

The loading of the building is considered as per following calculation

1. Dead Loads are applied as: -

- Self-weight of the structure is automatically taken by software itself.
- The self-weight of slab = $.150\text{m} \times 1 \times 1 \times 25 = 3.75 \text{ KN/m}^2$
- The floor finish load of slab = $.075\text{m} \times 1 \times 1 \times 25 = 1.875 \text{ KN/m}^2$
- Load due to masonry Wall = $0.23 \times 2.75 \times 20 = 12.65 \text{ KN/m}$

2. Live Loads

- The live load is considered 2 KN/m^2 on all floor and 3 KN/m^2 on balcony, landing and Corridor areas.

3. Earthquake Loads

- In this present work “response spectrum method” of analysis is used.
- As per “IS 1893-2005” Part-4 code book seismic loading is assigning to the structure.
- This load is taken in to account by specifying the zone III and soil type in which structure is assumed to be located.
- Zone: - 0.24
- Importance factor: - 1.2
- Damping ratio: - 5
- Type of structure: - 1
- Response reduction factor: - 5
- Rock and soil site factor: - 2

4. Wind load: -

In this work both models have been assigned these below given property for wind Intensity analysis.

- Calculate as per ASCE-7(2010)
- Building Classification Category: - III
- Basic Wind speed: - 47 mph
- Exposure Category: - B

Load Combinations

The following load and load combinations are considered during the analysis of the model inSTAAD.Pro:

LOAD AND LOAD COMBINATIONS

LOAD7SPECTRUMINXDIRECTIONEQLX

SPECTRUMQC1893TORECC0.05X0.0288ACCSCALE3.46741DAMP0.05

SOILTYPE2

REFERENCELOADR11.0

LOAD8SPECTRUMINZDIRECTIONEQLZ

SPECTRUMCQC1893TORECC0.05Z0.0288ACCSCALE3.77783DAMP0.05

SOILTYPE2

* FOR FOUNDATION RESULTS

LOADCOMB9SERVICE

41.051.061.0

LOADCOMB10SERVICE + EQLX

71.041.051.061.0

LOADCOMB11SERVICE - EQLX

7-1.041.051.061.0

LOADCOMB12SERVICE + EQLZ

81.041.051.061.0

LOADCOMB13SERVICE - EQLZ

8-1.041.051.061.0

LOADCOMB110SERVICE + EQLX

71.041.051.0

LOADCOMB111SERVICE - EQLX

7-1.041.051.0

LOADCOMB112SERVICE + EQLZ

81.041.051.0

LOADCOMB113SERVICE - EQLZ

8-1.041.051.0

*COLUMN DESIGN

LOADCOMB14LIMIT

41.551.561.5

LOADCOMB15LIMIT + EQLX

71.241.251.261.2

LOADCOMB16LIMIT – EQLX

7-1.241.251.261.2

LOADCOMB17LIMIT + EQLZ

81.241.251.261.2

LOADCOMB18LIMIT - EQLZ

8-1.241.251.261.2

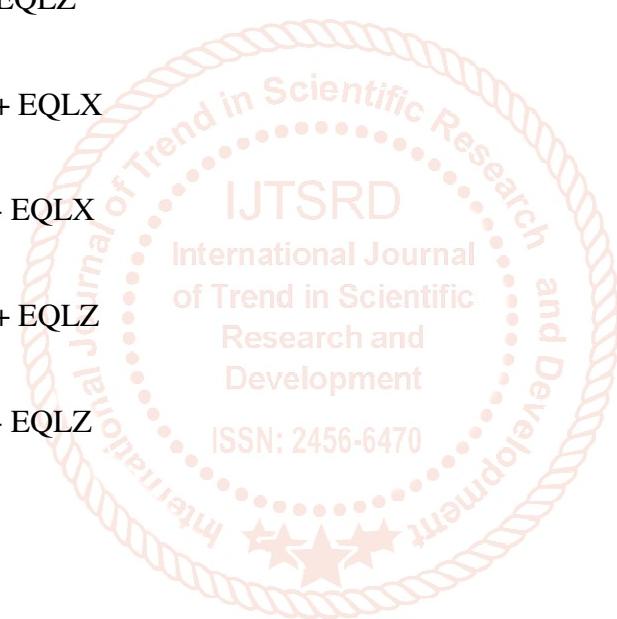
LOADCOMB19LIMIT + EQLX

71.541.551.5

LOADCOMB20LIMIT - EQLX

7-1.541.551.5

LOADCOMB21LIMIT + EQLZ



81.541.551.5

LOADCOMB22LIMIT - EQLZ

8-1.541.551.5

LOADCOMB23LIMIT + EQLX

71.540.950.9

LOADCOMB24LIMIT - EQLX

7-1.540.950.9

LOADCOMB25LIMIT + EQLZ

81.540.950.9

LOADCOMB26LIMIT - EQLZ

8-1.540.950.9

MEMBERPROPERTYINDIAN

170171174175192193196197202203206207338TO340343TO345366 -

367371372380TO382385TO387518TO520523TO525546547551552560 -

561TO562565TO567698TO700703TO705726727731732740TO742745 -

746TO747878TO880883TO885906907911912920TO922925TO9271058 -

1059TO10601063TO106510861087109110921100TO11021105TO11071238 -

1239TO12401243TO124512661267127112721280TO12821285TO12871418 -

1419TO14201423TO142514461447145114521460TO14621465TO14671598 -

1599TO16001603TO160516261627163116321640TO16421645TO16471790 -

179118341835PRISYD0.6ZD0.35

176177184188191194200201347348355356358362365368370373377 -

378527528535536538542545548550553557558707708715716718722 -

7257287307337377388878888958968989029059089109139179181067 -

106810751076107810821085108810901093109710981247124812551256 -

125812621265126812701273127712781427142814351436143814421445 -

1448145014531457145816071608161516161816221625162816301633 -

1637163817821786178917921826183018331836PRISYD0.32ZD0.6

181182198199346349353354374TO376379526529533534554TO556 -

559706709713714734TO736739886889893894914TO91691910661069 -

107310741094TO1096109912461249125312541274TO1276127914261429 -

143314341454TO1456145916061609161316141634TO1636 -

1639PRISYD0.4ZD0.95

12132930PRISYD0.4ZD0.95

14202126183189190195357363364369537543544549717723724729 -

897903904909107710831084108912571263126412691437144314441449 -

16171623162416291781178717881793182518311832 -

1837PRISYD0.32ZD1.275

343536172173204205341342383384521522563564701702743744 -

881882923924106110621103110412411242128312841421142214631464 -

1601160216431644PRISYD1.9ZD0.32

9TO1116TO18178TO180185TO187350TO352359TO361530TO532539 -

540TO541710TO712719TO721890TO892899TO9011070TO1072 -

1079TO10811250TO12521259TO12611430TO14321439TO1441 -

1610TO16121619TO16211778TO17801783TO17851822TO1824 -

1827TO1829PRISYD0.9ZD0.23

23242728PRISYD0.7ZD0.4

717279808792939699100103110116210211215TO220222TO231233 -

234237238240TO249252TO258260TO263265TO285287TO290 -

292TO297300TO307309310313314316TO323325TO330334335 -

388TO517568TO697748TO877928TO10571108TO12371288TO14171468 -

1469TO15971648TO17771794TO18211838TO1865PRISYD0.45ZD0.23

125TO81519222531TO343738PRISYD0.4ZD0.7

39TO7073TO7881TO8688TO9194959798101102104TO109 -

111TO115117TO169PRISYD0.45ZD0.3UNITMMSNEWTON

MEMBERPROPERTYINDIAN

208209212TO214221232235236239250251259264286291298299308 -

311312315324331TO333336337PRISYD450ZD230

UNITMETERKN

CONSTANTS

MATERIALCONCRETEMEMB349TO1416TO1820212629303536170TO209 -

212TO214221232235236239250251259264286291298299308311312 -

315324331TO333336TO387518TO567698TO747878TO9271058TO1107 -

1238TO12871418TO14671598TO16471778TO17931822TO1837 -

1866TO18731878TO1881

MATERIALBEAMMEMB39TO169210211215TO220222TO231233234237238 -

240TO249252TO258260TO263265TO285287TO290292TO297 -

300TO307309310313314316TO323325TO330334335388TO517 -

568TO697748TO877928TO10571108TO12371288TO14171468TO1597 -

1648TO17771794TO18211838TO1865

MATERIALCOLUMNMEMB125TO8151922TO25272831TO343738

SUPPORTS

1TO38FIXED

- For reliable method of analysis, the combined action of DL, LL, WL & EQ forces are considered i.e. **1.2 DL + 1.2 LL + 1.2 EQ + 1.2 WL**. The structures with different geometries and various floors have been modelled using STAAD.pro software. Total 26 combinations of different above-mentioned load conditions are generated and applied. For design of a slab and shear walls the four nodes plate is used in both models. These plates are supported by beam directly and transmit the load to the beams.
- The supports are taken as fixed support in building without floating columns and the cross sections are

assumed rectangular in geometry.

- The live load is taken as 2 KN/m² and floor load is taken as 3 KN/m². The wall load is considered as UDL of 15.81KN/m in all models. And shear wall load is considered UDL of 18.11 KN/m.
- Codes used for design are: RCC Design - IS 456:2000; Seismic Loads - IS 1893:2000(Part 1) and Wind Loads – ASCE 7. The building frames are analyzed in STAAD.pro V8i by modelling and the average displacement, beam stresses, slab stresses, storey drift and base shear are calculated to give a comparative result in between the different framing systems.
- The behavior of both framing systems is taken as a basic study on the modeled structures. The lateral drift/deflection ratio is checked against the clause 7.11.1 of IS-1893:2002 i.e. under transient seismic loads.
- The following parameters were considered to present a comparison between the different frames:
- Maximum Beam Shear
- Maximum Beam Moments
- Maximum Nodal Deflections
- Maximum Axial Load on Columns Footing
- Volume of Steel and Volume of concrete

RESULTS AND DISCUSSIONS

RESULTS

After finishing comparative study of the building's towers with and without floating columns a comparison is made on the basis of following points given below. Then final result is obtained by reading these tables.

MAXIMUM BENDING MOMENT

MAXIMUM SHARE FORCE

AXIAL LOAD ON COLUMNS FOOTING

NODAL DISPLACEMENT OF BEAMS

VOLUME OF STEEL AND VOLUME OF CONCRETE

MAXIMUM BENDING MOMENT

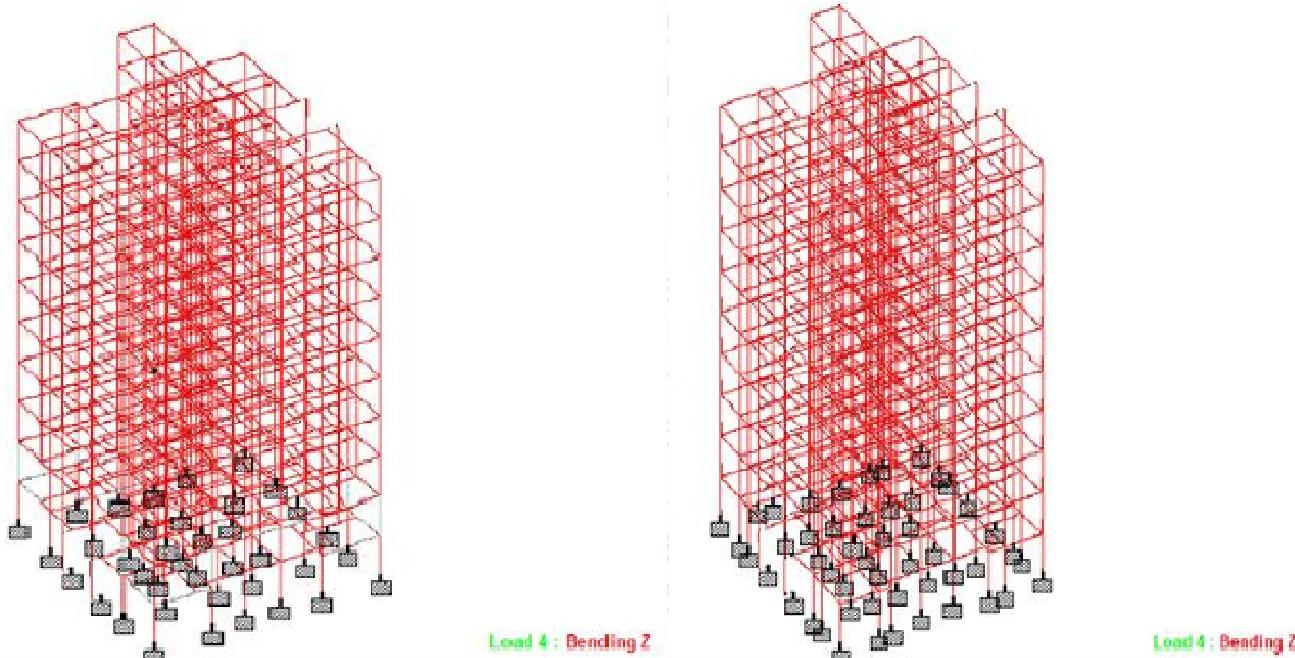
Table 5.1 Maximum Bending moment in building having floating column

	Node	L/C	Horizontal	Vertical	Horizontal	Moment		
			FxkN	FykN	FzkN	Mx N-m	My N-m	Mz N-m
Max Fx	4	4 LOAD CASE 1	15.068	1159.977	4.604	4552.079	3844.537	-9.78E+05
Min Fx	35	4 LOAD CASE 1	-17.842	1201.548	-2.182	-2159.295	1.82E+03	1.01E+06
Max Fy	13	4 LOAD CASE 1	-13.838	1651.41	-10.673	-9650.542	-5.50E-2	13590.423
Min Fy	10	6 LOAD CASE 3	0.054	40.223	0	0	0	-75.77
Max Fz	5	4 LOAD CASE 1	1.362	1360.66	27.518	26071.92	-0.029	-1345.647
Min Fz	2	4 LOAD CASE 1	1.36	1360.78	-27.522	-26081.31	-0.029	-1343.292
Max Mx	5	4 LOAD CASE 1	1.362	1360.66	27.518	26071.92	-0.029	-1345.647
Min Mx	2	4 LOAD CASE 1	1.36	1360.78	-27.522	-26081.31	-0.029	-1343.292
Max My	4	4 LOAD CASE 1	15.068	1159.97	4.604	4552.079	3844.537	-9.78E+05
Min My	3	4 LOAD CASE 1	15.049	1159.985	-4.606	-4557.404	-3846.94	-9.78E+05
Max Mz	35	4 LOAD CASE 1	-17.842	1201.548	-2.182	-2159.295	1821.806	1.01E+06
Min Mz	4	4 LOAD CASE 1	15.068	1159.977	4.604	4552.079	3844.537	-9.78E+05

Table 5.2 Maximum Bending moment in building without floating column

	Node	L/C	Horizontal	Vertical	Horizontal	Moment		
			FxkN	FykN	FzkN	Mx N-m	My N-m	Mz N-m
Max Fx	4	4 LOAD CASE 1	15.042	1151.649	-4.816	-4763.451	-4021.57	-9.76E+05
Min Fx	46	4 LOAD CASE 1	-18.413	1191.937	-2.371	-2344.687	1979.515	1.00E+06
Max Fy	20	4 LOAD CASE 1	3.349	1309.722	2.705	2234.537	0	-3407.29
Min Fy	14	6 LOAD CASE 3	0.04	39.52	0	0	0.00E+00	-176.213
Max Fz	16	4 LOAD CASE 1	-0.005	772.591	6.576	5940.732	0.00E+00	-134.069
Min Fz	17	4 LOAD CASE 1	-0.005	772.591	-6.576	-5940.73	0.00E+00	-134.069
Max Mx	16	4 LOAD CASE 1	-0.005	772.591	6.576	5940.732	0.00E+00	-134.069
Min Mx	17	4 LOAD CASE 1	-0.005	772.591	-6.576	-5940.73	0	-134.069
Max My	5	4 LOAD CASE 1	15.042	1151.649	4.816	4763.452	4021.57	-9.76E+05
Min My	4	4 LOAD CASE 1	15.042	1151.649	-4.816	-4763.451	-4021.57	-9.76E+05
Max Mz	46	4 LOAD CASE 1	-18.413	1191.937	-2.371	-2344.687	1979.515	1.00E+06
Min Mz	4	4 LOAD CASE 1	15.042	1151.649	-4.816	-4763.451	-4021.57	-9.76E+05

It is observed that maximum +VE bending moment in buiding having floating column is 4552.079N-m and for the without floating column is 5940.73N-m and maximum -Ve moment in the building having floating columns is -9650.54 N-m and for the building without floating columns is -5940.73 N-m.

**a. With floating column and shear wall****b. Without floating column and shear wall****Fig. 5.1 STAAD. Pro Model showing Bending moment of Building with and without floating column and shear wall**

MAXIMUM SHARE FORCE

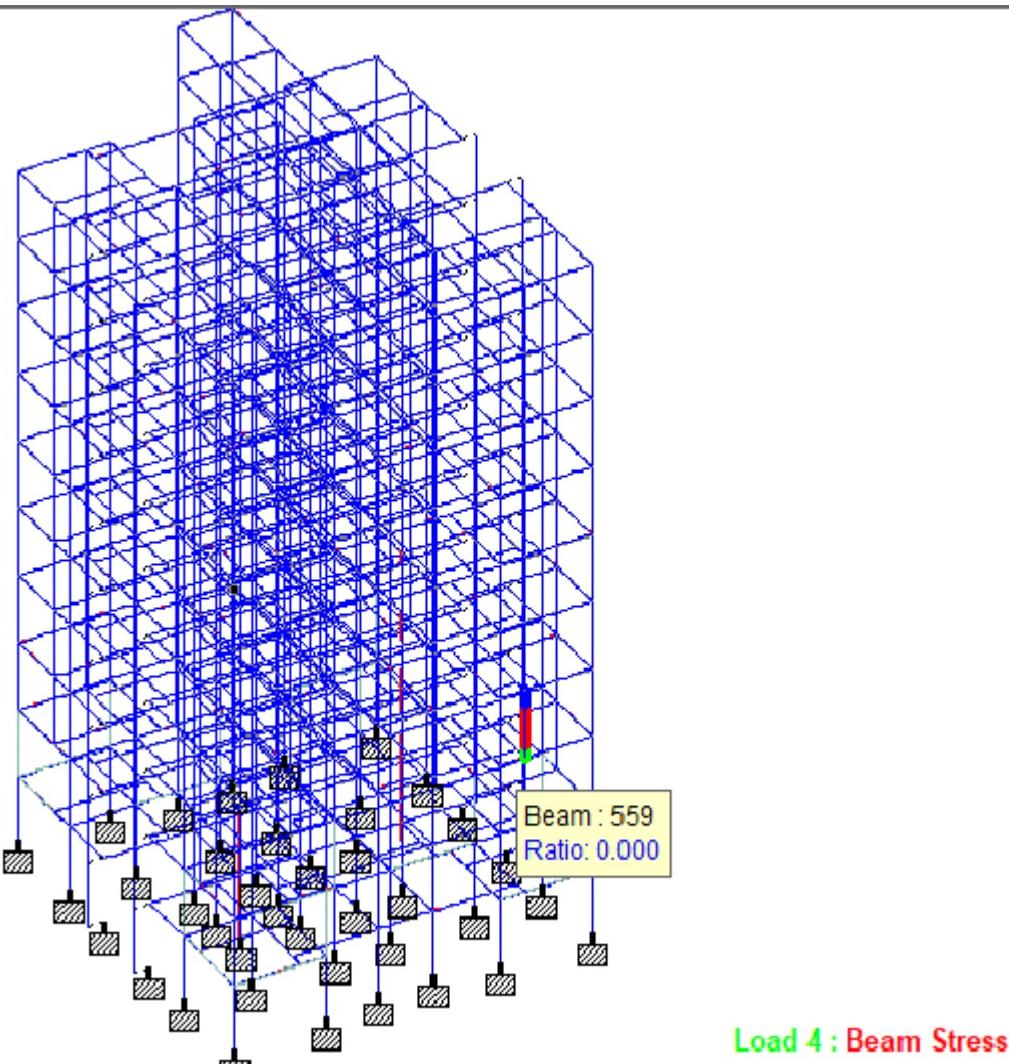
Table 5.3 Maximum share force on building having floating column

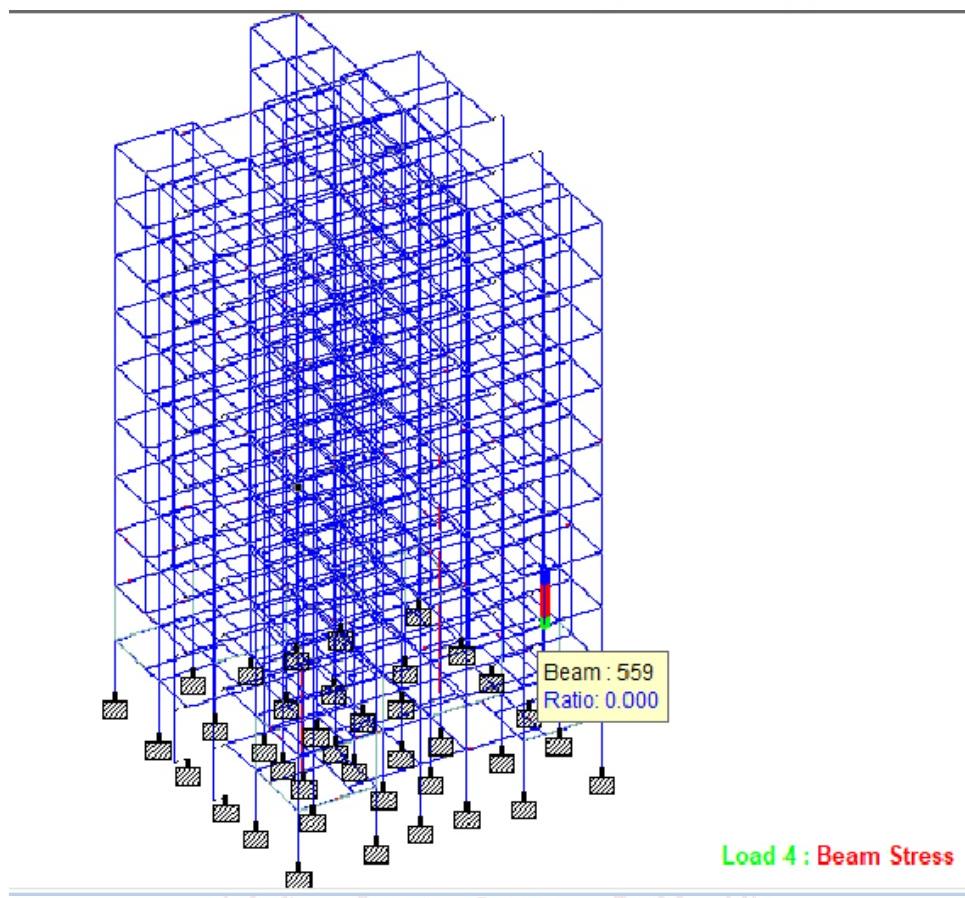
	Beam	L/C	Node	FxkN	FykN	FzkN	Mx N-m	My N-m	Mz N-m
Max Fx	13	4 LOAD CASE 1	13	1461.41	13.838	-10.673	-0.055	9650.542	13590.423
Min Fx	1639	4 LOAD CASE 1	870	-24.675	-14.843	-4.405	0.19	-4444.211	26928.666
Max Fy	333	4 LOAD CASE 1	201	0	229.645	0	134.024	0	1.74E+05
Min Fy	239	4 LOAD CASE 1	151	0	-164.709	0	3.943	0	1.20E+05
Max Fz	386	4 LOAD CASE 1	205	197.19	3.085	37.981	0.049	-76172.497	5633.188
Min Fz	381	4 LOAD CASE 1	200	197.2	3.088	-37.988	0.049	76185.51	5638.775
Max Mx	68	4 LOAD CASE 1	65	0	-0.923	0	9500.32	0	1728.528
Min Mx	65	4 LOAD CASE 1	62	0	-0.923	0	-9500.391	0	1728.337
Max My	381	4 LOAD CASE 1	200	197.2	3.088	-37.988	0.049	76185.51	5638.775
Min My	386	4 LOAD CASE 1	205	197.19	3.085	37.981	0.049	-76172.497	5633.188

Table 5.4 Maximum share force on building without floating column

	Beam	L/C	Node	FxkN	FykN	FzkN	Mx N·m	My N·m	Mz N·m
MaxFx	20	4 LOAD CASE 1	20	1149.722	-3.349	2.705	0	-2234.537	-3407.29
MinFx	51	4 LOAD CASE 1	52	0	43.63	0	57.73	0	22515.942
MaxFy	116	4 LOAD CASE 1	86	0	58.642	0	0.023	0	28122.161
MinFy	116	4 LOAD CASE 1	95	0	-58.561	0	0.023	0	28003.473
MaxFz	1626	4 LOAD CASE 1	727	98.882	-31.567	11.762	0	-15671.457	-46056.837
MinFz	1625	4 LOAD CASE 1	726	98.882	-31.567	-11.762	0	15671.456	-46056.837
MaxMx	94	4 LOAD CASE 1	85	0	23.131	0	10328.994	0	9260.255
MinMx	93	4 LOAD CASE 1	80	0	23.131	0	-10328.993	0	9260.255
MaxMy	1637	5 LOAD CASE 2	828	24.512	0.284	10.594	0	22090.441	-392.966
MinMy	1638	5 LOAD CASE 2	835	24.512	0.284	-10.594	0	-22090.436	-392.971
MaxMz	1626	4 LOAD CASE 1	811	50.242	-31.567	11.762	0	21966.809	54956.493
MinMz	1667	4 LOAD CASE 1	886	50.682	30.671	-11.636	0	-21864.038	-55575.137

It is observed that the maximum shear force in the building having floating columns is 1461.41KN and for the building without floating columns is 1149.72KN.

**a. With floating column and shear wall**



b. Without floating column and shear wall

Fig. 5.2 STAAD. Pro Model showing Maximum Beam stress in building with and without floating column and shear wall.

AXIAL LOAD ON COLUMNS FOOTING

Table 5.5 Axial load on columns of building having floating columns

Node	L/C	Force-X kN	Force-Y kN	Force-Z kN	Moment-X N-m	Moment-Y N-m	Moment-Z N-m
13	4	-13.838	1651.41	-10.673	-9650.542	-0.055	13590.423
12	4	-13.842	1650.727	10.654	9615.831	-0.055	13593.679
29	4	13.701	1646.046	10.309	9305.366	-0.055	-13477.185
30	4	13.704	1645.191	-10.35	-9357.604	-0.055	-13480.302
37	4	-1.587	1361.951	27.156	25729.071	-0.029	1553.37
34	4	-1.59	1361.376	-27.165	-25741.942	-0.029	1555.915
2	4	1.36	1360.738	-27.522	-26081.311	-0.029	-1343.292
5	4	1.362	1360.166	27.518	26071.492	-0.029	-1345.647
7	4	10.505	1350.255	-8.611	-8162.297	-0.029	-10331.615
8	4	10.502	1349.968	8.606	8151.425	-0.029	-10328.418
19	4	-7.041	1343.943	-1.522	-1444.498	-0.029	6914.179
15	4	-7.04	1343.878	1.524	1441.322	-0.029	6912.312
31	4	-10.501	1327.029	-6.652	-6305.658	-0.029	10314.236
21	4	-3.104	1322.845	2.599	2130.256	-0.044	3062.611
32	4	-10.452	1321.635	6.719	6364.243	-0.029	10266.615
22	4	6.651	1313.366	1.186	1121.315	-0.029	-6543.991
14	4	3.385	1311.407	3.121	2560.861	-0.044	-3355.909
20	4	3.384	1311.159	-3.166	-2631.52	-0.044	-3354.211
26	4	-3.104	1308.172	-3.147	-2615.279	-0.044	3062.161
25	4	6.594	1304.429	-0.524	-499.055	-0.029	-6487.617
38	4	-4.196	1204.97	-15.421	-14614.533	-0.029	4118.014
33	4	-4.201	1204.96	15.408	14597.084	-0.029	4122.015
1	4	4.128	1202.146	15.018	14227.254	-0.029	-4063.509
6	4	4.131	1202.032	-15.016	-14231.545	-0.029	-4066.732

35	4	-17.842	1201.548	-2.182	-2159.295	1821.806	1.01E+06
36	4	-17.822	1201.544	2.171	2146.101	-1813.049	1.01E+06
3	4	15.049	1159.985	-4.606	-4557.404	-3846.194	-9.78E+05
4	4	15.068	1159.977	4.604	4552.079	3844.537	-9.78E+05
9	4	0.326	1136.548	-0.021	-21.087	-0.011	-329.052
11	4	0.329	1136.534	0.02	19.644	-0.011	-330.992
10	4	3.448	989.669	0	-0.691	-0.011	-3180.028
16	4	-4.565	964.619	-0.926	-921.435	-0.011	4137.952
18	4	-4.562	964.599	0.925	919.44	-0.011	4136.182
17	4	-3.375	946.837	0	-0.711	-0.011	3051.858
27	4	6.912	746.39	-4.498	-4422.038	-0.029	-6569.38
28	4	6.914	746.253	4.485	4407.48	-0.029	-6571.424
23	4	0.604	623.36	-0.788	-775.134	-0.029	-592.624
24	4	0.606	623.233	0.765	751.171	-0.029	-594.055

Table 5.6 Axial load on columns of building without floating columns

Node	L/C	Force-X kN	Force-Y kN	Force-Z kN	Moment-X N-m	Moment-Y N-m	Moment-Z N-m
20	4	3.349	1309.722	2.705	2234.537	0	-3407.29
26	4	3.349	1309.722	-2.705	-2234.532	0	-3407.289
32	4	-3.298	1306.172	-2.702	-2231.949	0	3166.761
27	4	-3.298	1306.172	2.702	2231.954	0	3166.762
46	4	-18.413	1191.937	-2.371	-2344.687	1979.515	1.00E+06
47	4	-18.413	1191.937	2.371	2344.688	-1979.515	1.00E+06
4	4	15.042	1151.649	-4.816	-4763.451	-4021.57	-9.76E+05
5	4	15.042	1151.649	4.816	4763.452	4021.57	-9.76E+05
15	4	-0.085	1080.827	-0.741	-736.755	0	-305.232
13	4	-0.085	1080.827	0.741	736.756	0	-305.231
21	4	3.703	1033.147	0.589	558.011	0	-3721.69
25	4	3.703	1033.147	-0.589	-558.01	0	-3721.69
28	4	-3.878	1008.677	0.124	117.941	0	3730.167
31	4	-3.878	1008.676	-0.124	-117.941	0	3730.167
14	4	3.408	985.859	0	0	0	-3494.85
7	4	4.316	964.301	4.739	4657.529	0	-4340.548
2	4	4.316	964.301	-4.739	-4657.529	0	-4340.548
44	4	-4.228	963.896	-4.735	-4654.271	0	3755.221
49	4	-4.228	963.896	4.735	4654.271	0	3755.221
24	4	-3.851	951.06	0.525	521.63	0	3133.876
22	4	-3.851	951.06	-0.525	-521.63	0	3133.876
23	4	-3.407	947.197	0	0	0	2729.126
3	4	2.582	919.152	3.324	3267.044	0	-2697.468
6	4	2.582	919.152	-3.324	-3267.043	0	-2697.468
48	4	-2.501	919.082	-3.302	-3245.098	0	2119.267
45	4	-2.501	919.082	3.302	3245.098	0	2119.268
40	4	1.986	892.675	-4.586	-4345.599	0	-2033.338
41	4	1.986	892.675	4.586	4345.6	0	-2033.338
11	4	-1.811	883.71	6.114	5793.561	0	1698.614
10	4	-1.811	883.71	-6.114	-5793.56	0	1698.614
9	4	-1.749	818.02	5.865	5298.142	0	1580.159
12	4	-1.749	818.02	-5.865	-5298.14	0	1580.159
39	4	1.835	813.807	5.857	5291.428	0	-1941.947
42	4	1.835	813.807	-5.857	-5291.426	0	-1941.947

It is observed that maximum axial load in the building having floating columns is 1651.9 KN and for the building without floating columns is 1309.72 KN.

NODAL DISPLACEMENT OF BEAMS**Table 5.7 Maximum Nodal displacement in building having floating columns**

			Horizontal	Vertical	Horizontal	Resultant	Rotational			
			Node	L/C	X mm	Y mm	Z mm	mm	rX rad	rYrad
Max X	906	5 LOAD CASE 2	0.117	-0.624	0	0.635	0	0	0	0
Min X	914	4 LOAD CASE 1	-0.553	-2.729	-0.001	2.784	0	0	0	0
Max Y	1	4 LOAD CASE 1	0	0	0	0	0	0	0	0
Min Y	734	4 LOAD CASE 1	-0.14	-8.212	0	8.213	-0.001	0	0	-0.01
Max Z	375	4 LOAD CASE 1	-0.02	-2.298	0.001	2.298	0	0	0	0
Min Z	901	4 LOAD CASE 1	-0.55	-4.452	-0.002	4.486	0	0	0	0
Max rX	45	4 LOAD CASE 1	-0.001	-5.438	0	5.438	0.003	0	0	-0.01
Min rX	40	4 LOAD CASE 1	-0.001	-5.438	0	5.438	-0.003	0	0	-0.01
Max rY	627	4 LOAD CASE 1	-0.098	-2.982	0.001	2.984	0	0	0	0
Min rY	901	4 LOAD CASE 1	-0.55	-4.452	-0.002	4.486	0	0	0	0
Max rZ	184	4 LOAD CASE 1	0.001	-4.898	0	4.898	0	0	0	0.03
Min rZ	148	4 LOAD CASE 1	0.001	-5.261	0	5.261	0	0	0	-0.03
Max Rst	734	4 LOAD CASE 1	-0.14	-8.212	0	8.213	-0.001	0	0	-0.001

Table 5.8 Maximum Nodal displacement in building without floating columns

			Horizontal	Vertical	Horizontal	Resultant	Rotational			
			Node	L/C	X mm	Y mm	Z mm	mm	rXrad	rYrad
Max X	1	4 LOAD CASE 1	0	0	0	0	0	0	0	0
Min X	918	4 LOAD CASE 1	-0.822	-2.714	0	2.836	0	0	0	0
Max Y	1	4 LOAD CASE 1	0	0	0	0	0	0	0	0
Min Y	793	4 LOAD CASE 1	-0.385	-6.796	0	6.807	0.001	0	0	-0.01
Max Z	883	5 LOAD CASE 2	-0.163	-0.539	0	0.563	0	0	0	0
Min Z	927	4 LOAD CASE 1	-0.822	-2.701	0	2.824	0	0	0	0
Max rX	745	4 LOAD CASE 1	-0.385	-2.811	0	2.837	0.002	0	0	0
Min rX	750	4 LOAD CASE 1	-0.385	-2.811	0	2.837	-0.002	0	0	0
Max rY	913	4 LOAD CASE 1	-0.822	-4.257	0	4.336	0	0	0	0
Min rY	913	5 LOAD CASE 2	-0.069	-0.984	0	0.987	0	0	0	0
Max rZ	147	4 LOAD CASE 1	-0.031	-3.004	0	3.004	0	0	0	0.001
Min rZ	122	5 LOAD CASE 2	-0.01	-5.282	0	5.282	-0.001	0	0	-0.002
Max Rst	793	4 LOAD CASE 1	-0.385	-6.796	0	6.807	0.001	0	0	-0.001

It is observed that maximum Nodal displacement in the building having floating columns is 8.213mm and for the building without floating columns is 6.807mm.

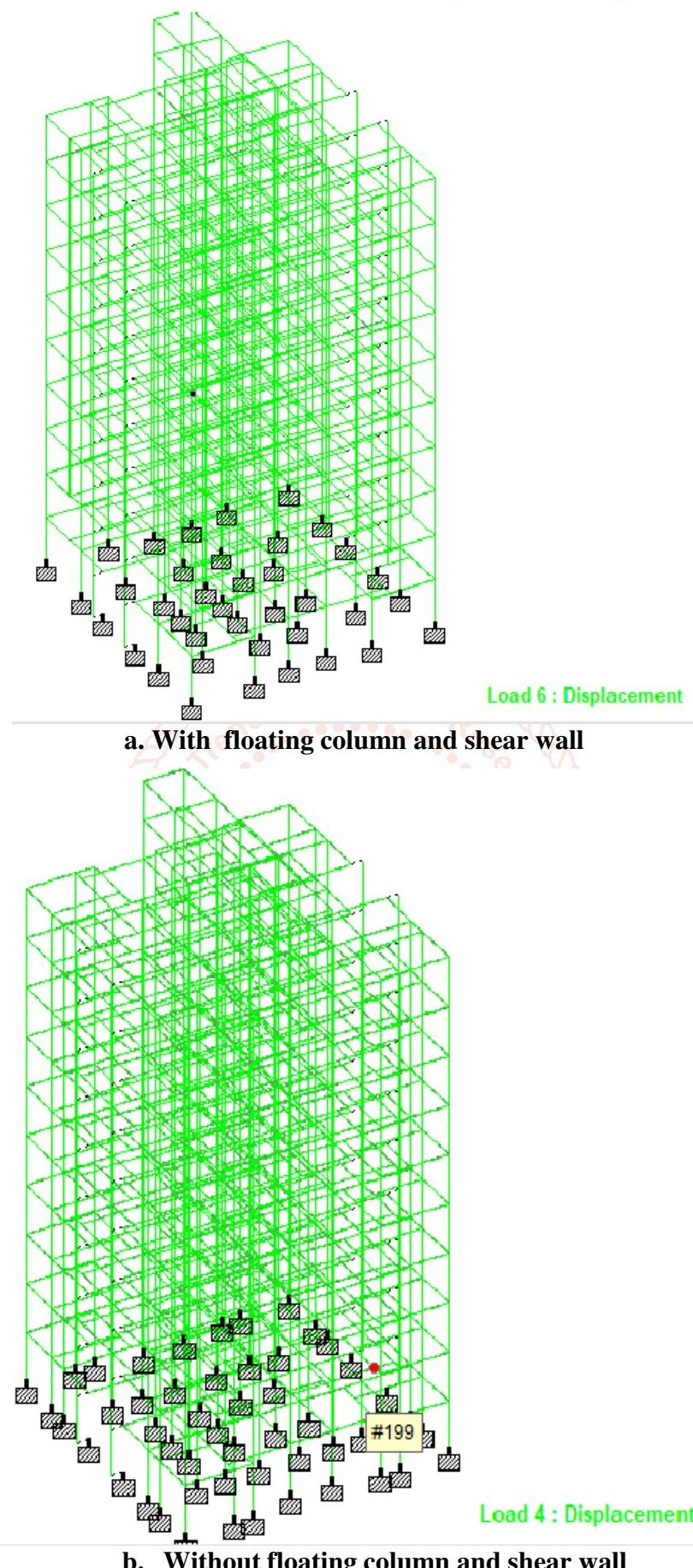


Fig. 5.3 STAAD. Pro Model showing Nodal displacement in Building with and without floating column and shear wall

VOLUME OF STEEL AND VOLUME OF CONCRETE

1. TOTAL VOLUME OF CONCRETE FOR BUILDING HAVING FLOATING COLUMN = 654.6 CUM
2. VOLUME OF STEEL

BAR DIA (in mm)	WEIGHT (in New)
8	125821
10	76746
12	183721
16	126834
20	75764
25	24383
32	39396

*** TOTAL= 652665 = 65266.5 KG

3. TOTAL VOLUME OF CONCRETE FOR BUILDING WITHOUT FLOATING COLUMN = 666.4 CUM

4. VOLUME OF STEEL

BAR DIA (In mm)	WEIGHT (in New)
8	130674
10	84173
12	203828
16	122924
20	78177
25	22385
32	62389

*** TOTAL= 704550 = 70455.0 KG

It is observed that The Quantity of concrete for building having floating columns is 654.6 CUM and for Building without floating columns is 666.4 CUM. Steel for building having floating columns is 65266.5 KG and for Building without floating columns is 70455.0 KG. There is small difference in quantity of concrete but major difference observed in volume of steel.

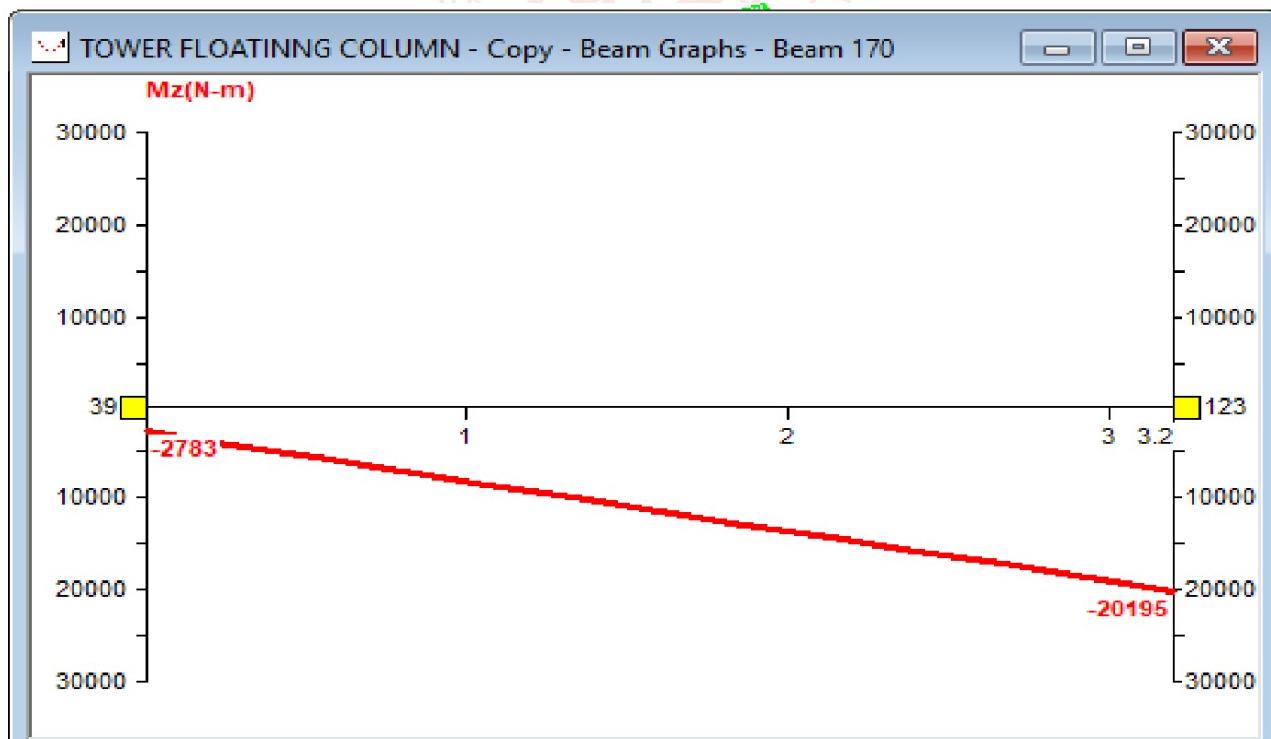


Fig. 5.4 Maximum bending moment in beam building with floating column

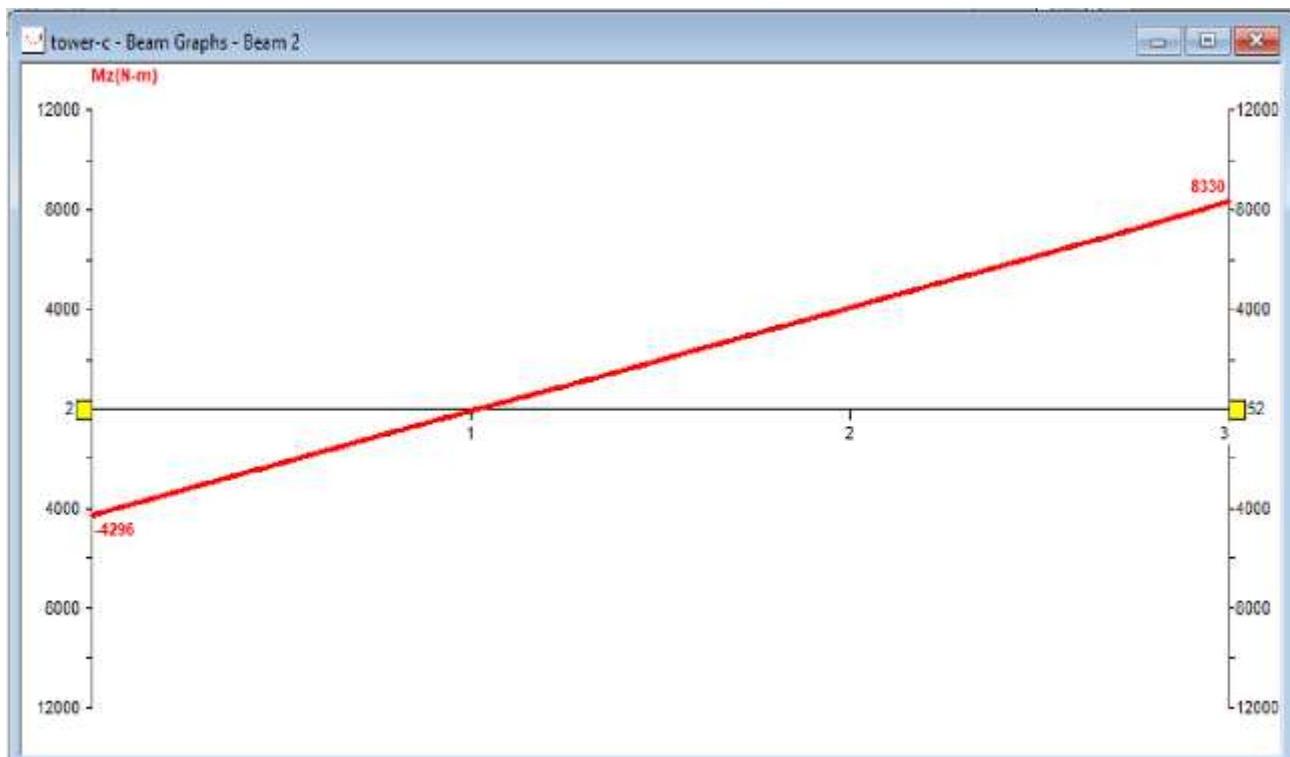


Fig 5.5 Maximum bending moment in beam building without floating column

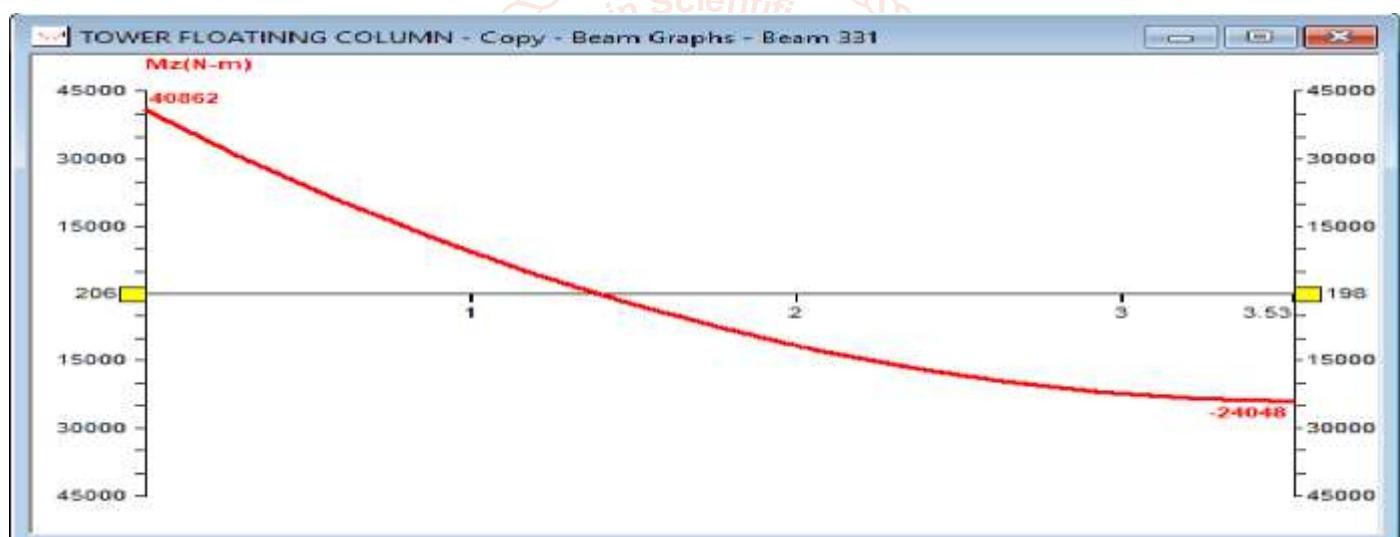


Fig. 5.6 Maximum moment in beam for building having floating columns

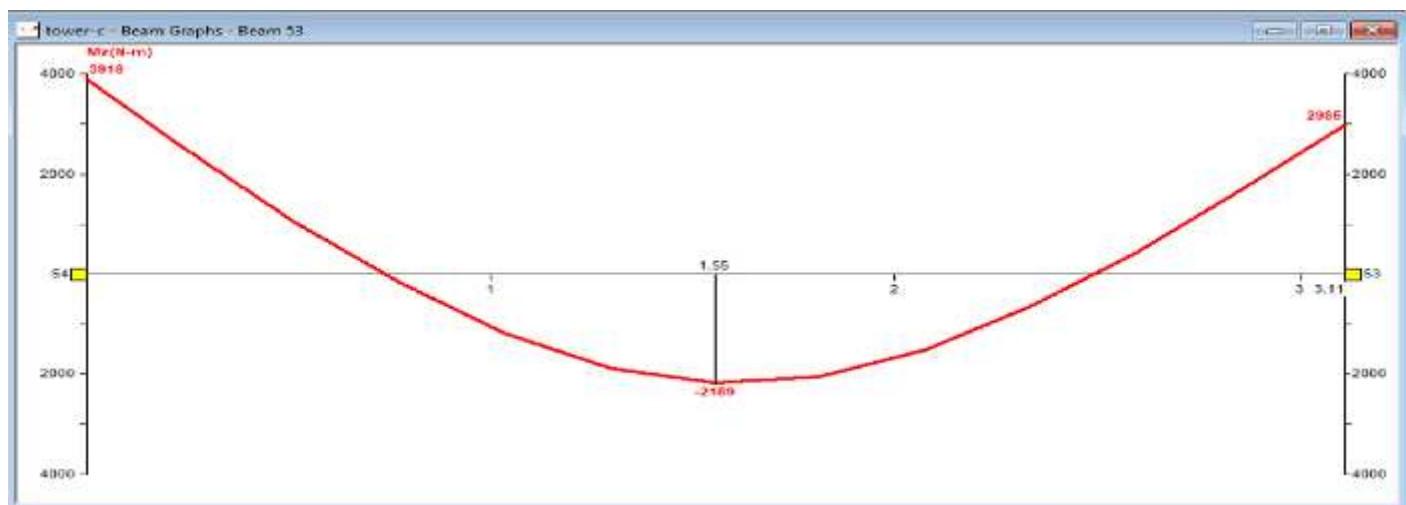


Fig. 5.7 Maximum moment in beam for building without floating columns

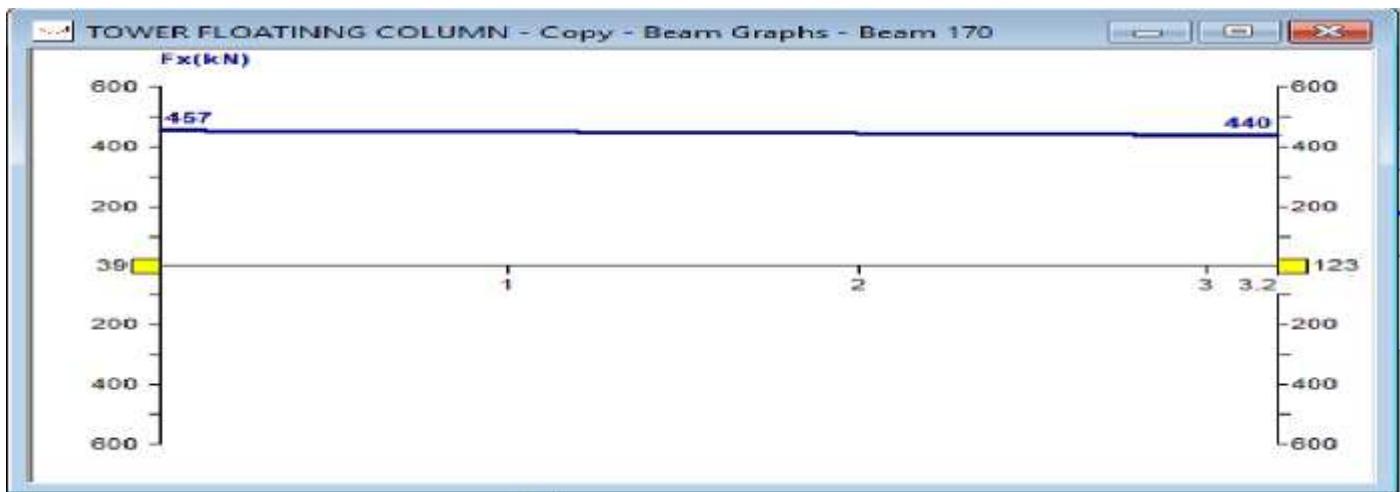


Fig. 5.8 Maximum shear force in column for building having floating columns

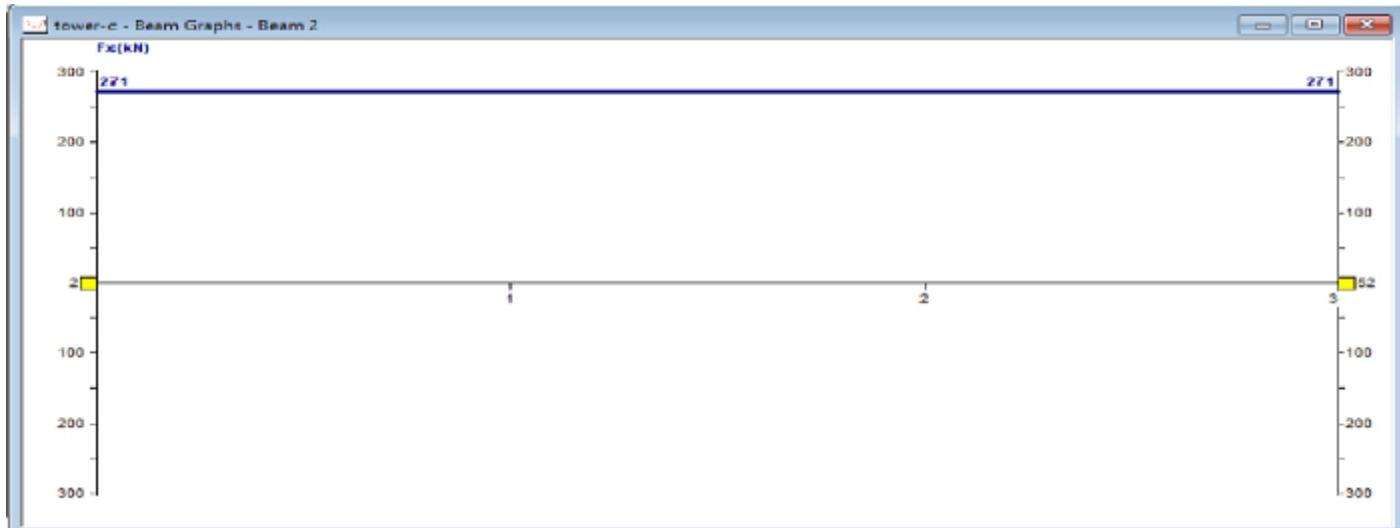


Fig. 5.9 Maximum shear force in column for building without floating columns

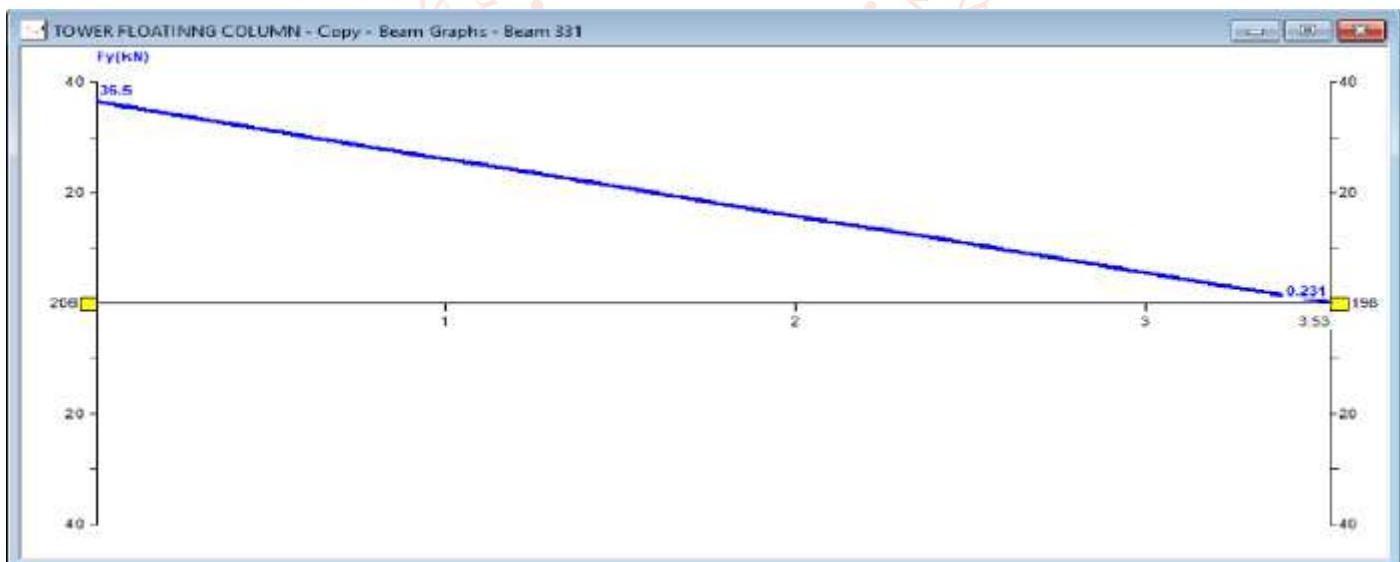


Fig. 5.10 Maximum shear force in beam for building having floating columns

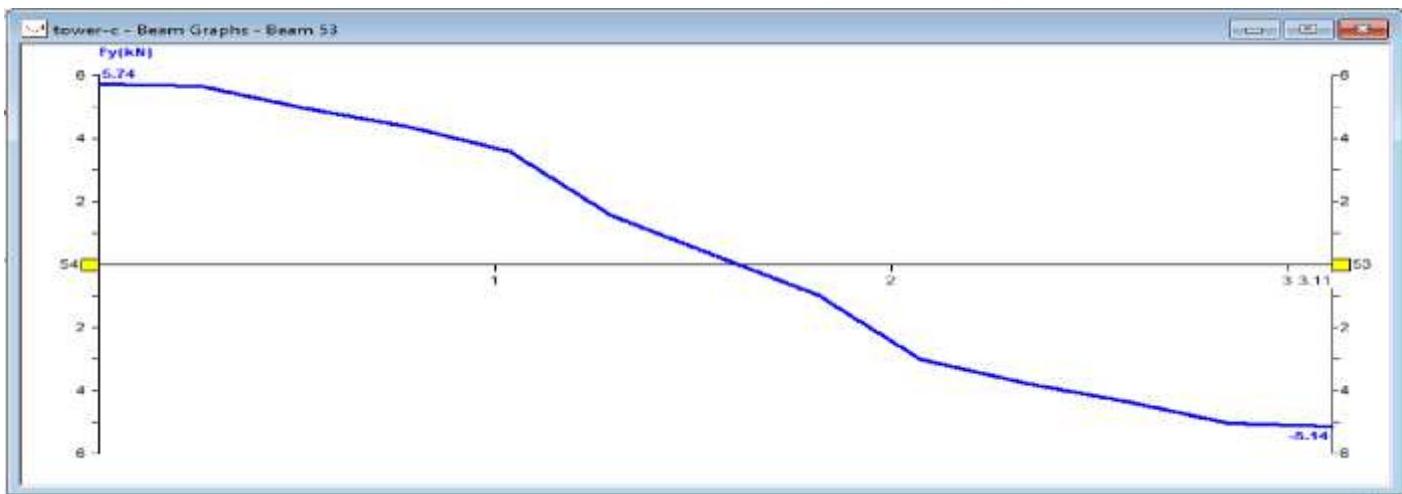


Fig. 5.11 Maximum shear force in beam for building without floating columns

CONCLUSIONS & FUTURE SCOPE OF WORK

From the above study following conclusions can be made:

- No. of columns are less in floating column building as comparison to tall building without using floating column
- The maximum +Ve moment in the building having floating columns is 4552.079 N-m and for the building without floating columns is 5940.73 N-m. and maximum -Ve moment in the building having floating columns is -9650.54 N-m and for the building without floating columns is -5940.73 N-m. The detail comparison is given in Table No.-5.1 & 5.2.
- The maximum shear force in the building having floating columns is 1461.41KN and for the building without floating columns is 1149.72KN. The detail comparison is given in Table No.-5.3 & 5.4.
- The maximum axial load in the building having floating columns is 1651.9 KN and for the building without floating columns is 1309.72 KN. The detail comparison is given in Table No.-5.5&5.6.
- The maximum Nodal displacement in the building having floating columns is 8.213mm and for the building without floating columns is 6.807mm. The detail comparison is given in Table No.-5.7& 5.8.
- In this study we concluded that with increase in ground floor column the maximum displacement; inter storey drift values are reducing.
- The base shear and overturning moment vary with the change in column dimension.
- The vertical load and moment are more in columns supporting the shear wall. Hence there are need to increase the sizes of these columns.
- Hence there are more chances of settlement of these columns carrying heavy load or need to greater strength in footing.

- Shear wall provide large stiffness to the building in there placed direction, it reduces damage and sway effect on building
- Shear wall resists horizontal shear force occurs by seismic load and wind load. And hence it provides extra stability to the building.
- There is small difference in quantity of concrete in building having floating columns and building without floating columns. The Quantity of concrete for building having floating columns is 654.6 CUM and for Building without floating columns is 666.4 CUM.

FUTURE SCOPE OF WORK

- Due to changing of the zone, the earthquake intensities will also be changed. Hence In such condition, the analysis can be done for other different zone.
- In this study I am using corner shear wall, similar study can be continued with different types of shear wall and ground conditions.
- The analysis can be performed by using conventional Slabs in future different type of slab is used.
- Same study can be done in other different conditions.

REFERENCES

- [1] Awkar J. C. and Lui E.M, "Seismic analysis and response of multistory semirigid frames", Journal of Engineering Structures, Volume 21, Issue 5, Page no: 425- 442,1997.
- [2] Balsamoa A, Colombo A, Manfredi G, Negro P &Prota P (2005), "Seismic behavior of a full-scale RC frame repaired using CFRP laminates". Engineering Structures 27 (2005) 769– 780.
- [3] Bardakis V.G., Dritsos S.E. (2007), "Evaluating assumptions for seismic assessment of existing buildings ".Soil Dynamics and Earthquake Engineering 27 (2007) 223– 233.

- [4] Broderick B.M., Elghazouli A.Y. and Goggins J, "Earthquake testing and response analysis of concentrically-braced sub-frames", *Journal of Constructional Steel Research*
- [5] Dr. S. B. Shinde and N.B. Raut, Effect of Change in Thicknesses and Height in Shear Wall on Deflection of Multistoried Buildings. *International Journal of Civil Engineering and Technology*, 7, 2016, pp.587–591.
- [6] Floating column and soft story in different earthquake zones", *International Journal of Research in Engineering and Technology*, vol 2, Issue 4, ISSN 2321-7308.
- [7] Han, S.W., Moon, K.H., and Chopra , A.K. (2010), — Application of MPA to estimate probability of collapse of structures, *Earthquake engineering and structural dynamics*, DOI: 10.1002/eqe.992.
- [8] Hanganu, A.D., Onate, E., and Barbat, A.H. (2002), —A finite element methodology for local/global evaluation in civil engineering structures, *Computers & Structures*, Vol.80, pp. 1667-1680.
- [9] Hardik Bhensdadia and Siddharth Shah "Pushover Analysis of RC Frame structure with
- [10] Hartley Gilbert and Abdel-Akher Ahmed, "Analysis of building frames" *Journal of Structural Engineering*, Vol. 119, No. 2, Page no:468-483,1993.
- [11] Haselton, C.B., and Deierlein, G.G. (2007), —Assessing seismic collapse safety of modern reinforced concrete frame buildings, PEER Rep. 2007/08. PEER Center, Univ. of California, Berkeley, CA.
- [12] Haselton, C.B., Liel, A., Deierlein, G.G., Dean, B.S., and Chou, J.S. (2011),
- [13] —Seismic Collapse Safety of Reinforced Concrete Buildings. I: Assessment of Ductile Moment Frames, *Journal of Structural Engineering*, ASCE, Vol. 137.
- [14] Hatzigeorgiou, G.D.. and Liolios, A.A. (2010), —Nonlinear behaviour of RC frames under repeated strong ground motions, *Soil dynamics and earthquake engineering*, Vol. 30, No.10, pp.1010 – 1025.
- [15] Hisada, T., Nakagawa, K., and Izumi, M., (1962), —Earthquake response of structures having various restoring force characteristics, In proceedings of Japan National conference on Earthquake Engineering, 1962, pp. 63 – 68.
- [16] K. N. V. Prasada Rao, K. Seetharamulu, and S. Krishnamoorthy, "Frames with staggered panels: experimental study", *Journal of Structural Engineering*, VOL 110, No. 5, Page no: 1134-1148,1984.
- [17] M. Rajesh Reddy, Dr. N. Srujana and N. Lingeshwaran, Effect of Base Isolation in Multistoried Reinforced Concrete Building. *International Journal of Civil Engineering and Technology*, 8(3), 2017, pp. 878–887.
- [18] Maisom Bruce F. and Ventura Carlos E., "DYNAMIC ANALYSIS OF THIRTEEN-STORY BUILDING", *Journal of Structural Engineering*, Vol. 117, No. 12, Page no:3783-3803,1991.
- [19] Mortezaei A., Ronagh H.R., Kheyroddin A., (2009), "Seismic evaluation of FRP strengthened RC buildings subjected to near-fault ground motions having fling step". *Composite Structures* 92 (2010)1200–1211.
- [20] Niroomandia A., Maherib A, Maherib Mahmoud R., Mahini S.S. (2010) "Seismic performance of ordinary RC frames retrofitted at joints by FRP sheets". *Engineering Structures* 32 (2010) 2326-2336.
- [21] Ozyigit H. Alper, "Linear vibrations of frames carrying a concentrated mass", *Mathematical and Computational Applications*, Vol. 14, No. 3, pp. 197-206,2009
- [22] Petyt Maurice (2010), "Introduction to Finite element vibration analysis" Cambridge University Press, New York.
- [23] SekulovicMiodrag, Salatic Ratko and NefovskaMarija, "Dynamic analysis of steel frames with flexible connections", *Journal of computer and structures*, Volume 80, Issue 11, Page no: 935-955, Volume 80, 2002.
- [24] Srikanth.M and Yogeendra. R "Seismic Response of complex buildings with Floating column for zone ii and zone v", *International journal of Engineering and Research Online*, vol 2, issue 4, 2014.
- [25] Vasilopoulos A.A and Beskos D.E., "Seismic design of plane steel frames using advanced methods of analysis", *Soil Dynamics and Earthquake Engineering* Volume 26, Issue 12, December 2006, Pages 1077-1100.
- [26] Williams Ryan J., Gardoni Paolo, Bracci Joseph M., (2009), "Decision analysis for seismic retrofit of structures". *Structural Safety* 31 (2009)188–196.
- [27] Wilson E.L "Three dimensional Static and Dynamic analysis of structures-A physical approach with emphasis on earthquake engineering", *Computers and Structures*, Inc Publication, 3rd Edition2002.